2 Setting

This chapter provides a brief overview of the water resources of the area, river and reservoir operations, and agency responsibilities. For more information on Reclamation facilities and operations the reader is directed to other Reclamation publications (Reclamation, 1996a; 1996b; 1997).

2.1 Snake River and Tributaries

The Snake River and its tributaries (see frontispiece) drain about 103,200 square miles in western Wyoming, southern and central Idaho, northern Utah, northern Nevada, eastern Oregon, and southeast Washington.

The Snake River is about 1,000-miles long and is the largest tributary of the Columbia River. It originates in Yellowstone National Park at an elevation in excess of 9500 feet, flows through western Wyoming and southern Idaho, and forms much of the Oregon/Idaho border and a small part of the Washington/Idaho border before turning west to join the Columbia River near Pasco, Washington. Most of the State of Idaho south of Lewiston is within the Snake River basin, which drains about 87 percent of the State.

Summers are warm and dry and winters are cold. Precipitation is low in the summer and early fall and higher during the late fall, winter, and spring. Although precipitation varies over the basin, average annual precipitation at lower elevations is generally about 15 inches and falls mostly in the winter as a mixture of rain and snow. Precipitation at higher elevations averages up to 40 inches per year with most falling as snow during the winter. These climatic conditions generally produce riverflows that can peak at very high levels as snow melts in the spring and early summer, decline throughout the summer to a minimum, and remain low during the fall and winter.

The Snake River and its tributaries fall into six natural divisions on the basis of flows and river operations. These are:

- Snake River basin upstream of Milner Dam (upper Snake River).
- Snake River basin from Milner Dam to Brownlee Dam (middle Snake River).
- Boise River basin.
- Payette River basin.
- Other tributaries upstream of Brownlee Dam.
- Main stem and tributaries between Brownlee Dam and Lower Granite Lake (lower Snake River).

2.1.1 Snake River Main Stem and Henrys Fork Upstream of Milner Dam

The Snake River valley upstream from Milner Dam contains a fertile plain and many natural water channels, which attracted indigenous peoples as well as the settlers from the east. Arid conditions in the west led to adoption of the prior appropriation doctrine of water rights which stipulated that stream water could be used without ownership of abutting land provided that the use did not interfere with an earlier use. As the population grew and spread throughout the upper Snake River basin, canals were built and storage dams constructed so springtime flows could be held for irrigation use during the hot summers. There are now seven Reclamation storage facilities located in the Snake River basin upstream of Milner Dam. The BIA operates two storage facilities for irrigation of lands on the Fort Hall Indian Reservation located along the main stem near Blackfoot and Pocatello, Idaho.

2.1.2 Snake River Main Stem from Milner Dam to Brownlee Dam

In much of this reach, the river has carved a channel down through the fertile lands to form a canyon that in many places is quite narrow and several hundred feet deep. The area, for the most part, is sparsely settled, but some of the surrounding plain is irrigated using highlift pumps. All of the irrigation development is private and much has been developed along a narrow strip close to the river to reduce pumping costs or the costs of long gravity diversion canals. All of the dams on this reach of the main stem are owned and operated by IPC.

The flow past Milner Dam is usually no more than 200 cfs during the summer except for flow augmentation releases. Thousand Springs, downstream from Milner Dam and near Hagerman, Idaho, is a spectacular outpouring from the eastern Snake River Plain Aquifer (SRPA) that provides an average annual flow to the main stem of about 5,300 cfs.

2.1.3 Boise and Payette Rivers

The lower Boise Valley is an area of intense irrigation development. Irrigated agriculture near the river expanded to higher bench lands, which required an extensive system of private canals to deliver water, but water supplies in the Boise River became inadequate to meet all the irrigation needs. Reclamation constructed the Boise Project in two parts–the Arrowrock Division and the Payette Division. Two Reclamation storage dams and one diversion dam and one Corps storage dam were constructed on the Boise River. Three Reclamation dams (two storage dams and one diversion dam) were constructed on the Payette River. Reclamation facilities provide most of the water supply for irrigation and flood control in these basins.

2.1.4 Other Tributaries Upstream of Brownlee Dam

Reclamation has constructed storage reservoirs in six other river basins upstream of Brownlee Dam. These are the Little Wood, Owyhee, Malheur, Weiser, Burnt, and Powder River basins. Five of these basins form a contiguous area in eastern Oregon and western Idaho (the Owyhee River basin extends into northern Nevada as well). The Little Wood River is a tributary of the Big Wood River, which joins the Snake River about 68 stream miles downstream from Milner Dam.

2.1.5 Snake River and Tributaries Between Brownlee Dam and Lower Granite Lake

This main stem reach is the site of the famous Hells Canyon. The only dams on this reach of the main stem are three IPC dams. Major tributaries are the Salmon and the Grande Ronde Rivers.

Several wilderness and recreation areas are located in this region. The large Frank Church River of No Return Wilderness, the smaller Gospel Hump Wilderness, and the Sawtooth National Recreation Area are located in the Salmon River basin. Located adjacent to the main stem and downstream from Hells Canyon Dam are the Hells Canyon Wilderness and the Hells Canyon National Recreation Area. All or a major portion of the Eagle Cap Wilderness and the Wenaha-Tucannon Wilderness lie within the Grande Ronde River basin.

As indicated earlier, the Clearwater River basin technically lies in this region but is outside the geographical scope of this analysis.

2.2 Existing Storage System

2.2.1 Federal Storage

All Reclamation storage facilities in the part of the Snake River basin considered in this analysis are located upstream from Brownlee Reservoir. As indicated earlier, the two Corps facilities (Lucky Peak and Ririe) are included as Reclamation storage for the purpose of this study. Reclamation facilities provide the only significant operational control over the flows of the main stem Snake River and the tributaries where they are located. The purpose of Reclamation reservoir storage is usually stated in the original authorizing legislation. Table 2-1 summarizes Reclamation project and storage facility authorizations for the Snake River basin by chronology of authorization. Subsequent Federal legislation, however, has added some purposes.

Table 2-2 summarizes Reclamation storage space in 21 on-stream storage facilities in the Snake River basin. Total active capacity is about 7 MAF. About 6.3 MAF of storage space (about 90 percent of active capacity) are contracted and essentially all of it is for irrigation; non-irrigation contracts total only 4,800 acre-feet of space for M&I and about 44,300 acre-feet for hydroelectric power. All space not contracted has been assigned to specific uses. These uses include minor amounts for mitigation and reservoir accounts (accumulation of sediment and evaporation of water) and larger amounts for conservation pools (Cascade and Deadwood), streamflow maintenance (Deadwood and Lucky Peak), and salmon flow augmentation (American Falls, Cascade, Deadwood, Lucky Peak, Jackson Lake, and Palisades).

The BIA operates three storage facilities in connection with Indian irrigation projects. Blackfoot Reservoir on the Blackfoot River and Grays Lake on Willow Creek south of Idaho Falls, Idaho provide a water supply for the Fort Hall Indian Project. Grays Lake, because of its small active capacity is operated primarily for fish and wildlife enhancement. Wild Horse Reservoir, located on the Owyhee River in northern Nevada, is operated to provide a water supply for the Duck Valley (Indian) Project.

Table 2-1 Authorization of Reclamation Projects and Storage Facilities			
Date	**Authorization**	**Storage Facility and Construction[1]**	**Original Authorized Purpose[2]**
1904/4/23	Minidoka Project authorized by the Secretary of the Interior (under the 1902 Reclamation Act) on April 23, 1904. Includes Minidoka Dam, Jackson Lake Dam, and American Falls Dam[3].	Minidoka Dam 1904-1906 Jackson Lake Dam, 1907, 1910-11, 1916 American Falls Dam 1925-27	Irrigation and power
1905/3/27	Boise Project authorized by the Secretary of the Interior (under the Reclamation Act of 1902) on March 27, 1905. Includes Deer Flat Dams (Lake Lowell).	Deer Flat Dams 1906-1908, 1909, 1911, 1913, 1938	Irrigation
1911/1/6	Arrowrock Dam authorized by the Secretary of the Interior (under 1902 Reclamation Act) on January 6, 1911.	Arrowrock Dam 1911-1915, 1937	Irrigation
1926/10/21	The Vale Project was authorized by the President (under the 1902 Reclamation Act) on October 21, 1926. Includes purchase of one-half interest in Warm Springs Reservoir and construction of Agency Valley Dam (Beulah Reservoir).	Agency Valley Dam 1935	Irrigation
1926/10/12	Owyhee Project authorized by the President (under 1902 Reclamation Act) on October 12, 1926.	Owyhee Dam 1927-1932	Irrigation
1928/10/19	Deadwood Dam authorized by the President (under 1902 Reclamation Act) on October 19, 1928.	Deadwood Dam 1929-1931	Irrigation and downstream power
1931/3/18	The Baker Project was authorized by the President on March 18, 1931. Includes Thief Valley Reservoir.	Thief Valley Dam 1931-1932	Irrigation
1935/8/13	The Burnt River Project was apparently authorized by the President on August 13, 1935. On September 25, 1935, the Secretary of the Interior found the Burnt River Project to be feasible. The President, apparently approving the project, approved an allotment of funds for construction of the reservoir on August 13, 1935. A copy of the Secretary's recommendation with date and approval signature of the President has not been found and does not appear to exist.	Unity Dam 1936-1939	Irrigation
1935/9/20	Grassy Lake Dam authorized by the President on September 20, 1935 (under 1902 Reclamation Act).	Grassy Lake Dam 1932-39	Irrigation
1935/9/20	Island Park Dam is authorized by the President on September 20, 1935 (under 1902 Reclamation Act).	Island Park Dam 1935-38	Irrigation
1935/12/19	Payette Division authorized by the President (under 1902 Reclamation Act) on December 19, 1935. Includes Cascade Dam.	Cascade Dam 1946-1948	Irrigation and power
1940/6/25	Anderson Ranch Dam authorized by the Secretary of the Interior on June 25, 1940	Anderson Ranch Dam	Irrigation, power, flood control, and

Table 2-1 Authorization of Reclamation Projects and Storage Facilities

Date	Authorization	Storage Facility and Construction[1]	Original Authorized Purpose[2]
	(under Reclamation Act of 1939)	1941-1950	conservation of fish and recreation
1946/7/24	Lucky Peak Dam authorized by Congress by Act of July 24, 1946.	Lucky Peak Dam 1949-1957	Flood control and irrigation
1950/9/30	Palisades Dam was authorized by Secretary of the Interior on December 9, 1941. The dam was reauthorized by Congress by Act of September 30, 1950.	Palisades Dam 1951-57	Irrigation, power, flood control, and fish and wildlife
1950/9/30	Minidoka Project, Northside Pumping Division authorized by Congress by Act of September 30, 1950.	None	Irrigation
1954/10/31	Michaud Flat Irrigation Project authorized by Congress by Act of August 31, 1954 (Public Law 741, 83rd Congress).	None	Irrigation
1956/8/6	The Little Wood River Project was authorized by Congress on August 6, 1956 (Public Law 993, 84th Congress). Included enlarging Little Wood River Dam.	Little Wood River Dam (enlargement)	Irrigation, flood control, recreation, and fish and wildlife preservation and propagation.
1959/9/9	The Bully Creek Extension was authorized by Congress by Act of September 9, 1959 (Public Law 86-248).	Bully Creek Dam 1963	Irrigation, flood control, recreation, and fish and wildlife preservation and propagation
1962/8/16	The Mann Creek Project was authorized by Congress by Act of August 16, 1962, (Public Law 87-589).	Mann Creek Dam 1965-1967	Irrigation, conserving and developing fish and wildlife, and recreation
1962/9/27	The Baker Project, Upper Division was authorized by Congress by Act of September 27, 1962 (Public Law 87-706). Includes Mason Dam.	Mason Dam 1968	Irrigation, flood control, conservation of fish and wildlife, and recreation.
1962/10/23	Ririe Dam authorized by Act of October 23, 1962.	Ririe Dam[4] 1970-77	Flood control, irrigation, and recreation.
1973/12/28	Replacement of American Falls Dam was authorized by Congress by Act of December 28, 1973.	American Falls Dam Replacement 1976-78	Irrigation and power

[1]Multiple construction periods indicate reconstruction or additional construction to reach the current storage capacity.
[2]The Act of September 30, 1950, by reference, appears to authorize the upper Snake River Reservoir system to be operated for flood control in addition to other purposes. In addition, several flood control acts have essentially authorized flood control at all Reclamation reservoirs. Public Law 89-72 along with Public Law 102-575 have essentially authorized recreation (including fish and wildlife enhancement) at all Reclamation projects. However, this authorization is primarily for construction of facilities and management of lands and does not authorize a change in the use of storage space in a reservoir.
[3]Legislation in 1924 addresses purchase of Indian lands and expenditure of monies for construction of the reservoir; however, a specific document authorizing construction has not been identified.
[4]Constructed by the Corps, but operated by Reclamation.

Table 2-2 Reservoir Space in Bureau of Reclamation Reservoirs Upstream of Brownlee Dam (Acre-Feet)[i]

Reservoir	Total Capacity	Active Capacity				Inactive	Flood Surcharge[iii]	Dead
		Total	Contracted[ii]	Formally Assigned To Other Uses	Formally assigned to Flow Augmentation			
STATE OF WYOMING								
Grassy Lake	15,500	15,200	15,200				700	300
Jackson Lake	847,000	847,000	843,077		[iv]3,923		32,500	([v])
STATE OF IDAHO								
American Falls	1,672,600	1,672,600	1,663,640		[4] 8,952			
Anderson Ranch	493,200	423,200	422,800	[vi]400		[vii]41,000	10,500	29,000
Arrowrock	286,600	286,600	286,600				14,300	
Cascade	703,200	653,200	313,682	[viii]269,900	69,600	[ix]50,000	157,000	
Deadwood	162,000	161,900	56,851	[x]79,650	25,400	[xi]100	29,600	
Island Park	135,600	135,600	135,200			[xii]400	34,000	
Little Wood	30,000	30,000	28,000	2,000	0	0	3,300	
Lucky Peak[xiii]	293,100	264,400	71,018	[xiv]152,420	[xv]40,932	[xvi]28,700	13,900	
Mann Creek	12,500	10,900	10,900			[xvii]200	2,400	1,400
Minidoka (Walcott)	210,200	95,200	95,200			[xviii]115,000	10,000	unknown
Palisades	1,401,000	1,200,000	1,189,978		[xix]10,022	[xx]157,000	16,000	44,000
Ririe	100,500	90,500	80,500	[xxi]10,000		[xxii]6,000		4,000
STATE OF OREGON								
Beulah	59,900	59,900	59,900				6,100	
Bully Creek	31,600	30,000	30,000				7,300	1,600
Owyhee	1,120,000	715,000	715,000			[xxiii]405,000		
Phillips Lake	95,500	90,500	73,500	17,000		[xxiv]1,500	16,000	3,500
Thief Valley	13,300	13,300	13,300					
Unity	25,500	25,000	24,970				3,600	500
Warm Springs	192,400	191,000	191,000					1,400
TOTALS	7,901,200	7,011,000	6,320,316	531,370	158,829	804,900	357,200	85,700
TOTAL (Formally Assigned to Other Uses and Flow Augmentation)					690,199			

2.2.2 Non-Federal Storage

There are numerous small reservoirs owned by a variety of individuals and entities throughout the Snake River basin. However, the total amount of storage, other than IPC, is small and the operations of these facilities is generally not affected by Reclamation operations.

IPC owns numerous facilities and is the only non-Federal entity with significant storage in the Snake River basin. Most of the IPC facilities are operated as run-of-river or have some capability for load following. Brownlee Reservoir with an active capacity of 975,000 acre-feet, is the largest reservoir.

2.2.3 Riverflows and Basin Outflow

Average annual flow of the main stem Snake River and various tributaries vary widely by location, due to tributary inflows, diversions, and interactions with underlying aquifers. For example, flow at Heise, upstream of the Henrys Fork confluence, averages about 4.5 MAF while flow past Milner Dam, well downstream, averages less than 2 MAF. The comparatively low flow past Milner is due in part to the operation of large reservoirs and the diversion of streamflows for irrigation. In contrast, the average flow at King Hill further downstream, is about 6.5 MAF. This increased flow is due primarily to inflow at Thousands Springs, other tributary inflow, irrigation return flows, and less intense irrigation development downstream of Milner Dam. Average flow of the main stem near Weiser, Idaho is about 12 MAF.

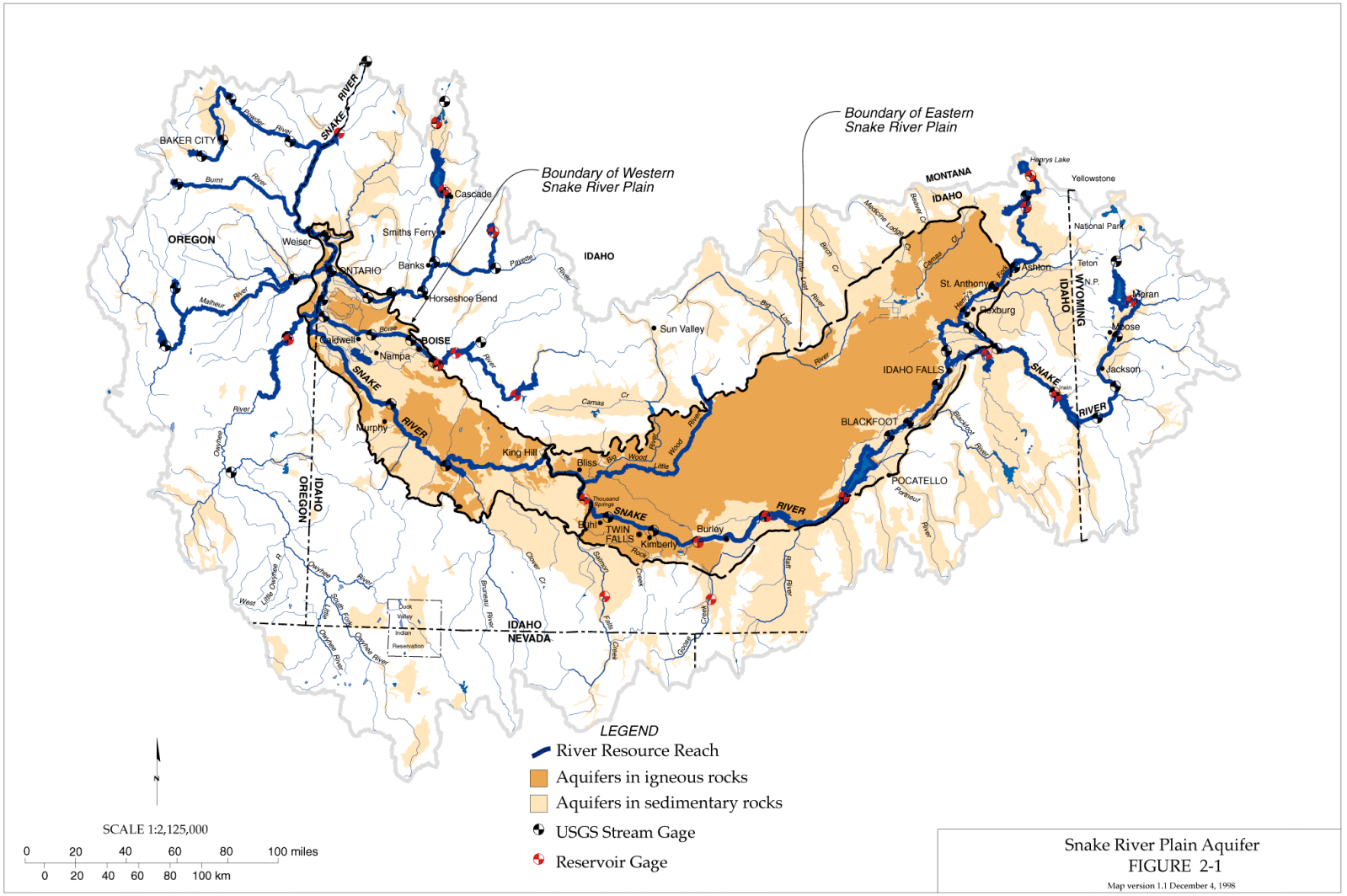
The average outflow of the Snake River at Lewiston, Idaho (upper end of Lower Granite Lake) is about 36 MAF. Nearly one-half of this flow is due to the combined flows of the Salmon, Clearwater, and Grande Ronde Rivers. Average annual outflow at Hells Canyon Dam is about 14 MAF.

2.3 Groundwater

2.3.1 Background

Groundwater is an integral part of the water supply in the Snake River basin and occurs to various degrees throughout the basin. The SRPA is one of the largest groundwater systems in the United States, containing about 250 MAF in the top 500 feet. The SRPA is separated into eastern and western regions on the basis of unique geohydrologic characteristics. The eastern SRPA covers about 10,800 square miles and is composed primarily of several thousand feet of layered basalt (Lindholm, 1996). It underlies the Snake River basin from near St. Anthony, in Fremont County, to King Hill, in Elmore County. The western SRPA system is smaller, covering about 4,800 square miles, and is composed primarily of up to 5,000 feet of sedimentary deposits of silt, clay, sand, and gravel with sporadic basalt interflow zones. The western SRPA underlies the Snake River basin from King Hill to Weiser. Most of the water in the western SRPA is located in the Boise and Payette River basins.

The extent of the SRPA is shown in figure 2-1 along with other aquifers in the basin. Aquifers in the subbasins tributary to the Snake River provide groundwater for use within the individual subbasins and provide various amounts of recharge to the SRPA in the form of subsurface groundwater inflow


Boundary of Western Snake River Plain
Boundary of Eastern Snake River Plain
OREGON
IDAHO
NEVADA
WYOMING
MONTANA
BAKER CITY
Weiser
ONTARIO
Cascade
Smiths Ferry
Banks
Horseshoe Bend
Caldwell
Nampa
BOISE
Sun Valley
Murphy
King Hill
Bliss
Buhl
TWIN FALLS
Kimberly
Burley
IDAHO FALLS
BLACKFOOT
POCATELLO
St. Anthony
Ashton
Rexburg
Teton
N.P.
Moran
Moose
Jackson
Yellowstone
National Park
Henrys Lake
SNAKE RIVER
Boise River
Payette River
Malheur River
Owyhee River
Big Wood River
Little Wood River
Big Lost River
Camas Cr
Blackfoot River
Portneuf River
Bruneau River
Salmon Falls Creek
Goose Creek
Clover Cr
Duck Valley Indian Reservation
Thousand Springs
LEGEND
River Resource Reach
Aquifers in igneous rocks
Aquifers in sedimentary rocks
USGS Stream Gage
Reservoir Gage
SCALE 1:2,125,000
0 20 40 60 80 100 miles
0 20 40 60 80 100 km
Snake River Plain Aquifer
FIGURE 2-1
Map version 1.1 December 4, 1998

Under natural conditions, recharge to the eastern SRPA occurs primarily from deep percolation of rainfall and subsurface inflow from tributary aquifers. Expansion of irrigated agriculture in the late 1800's caused significant recharge due to deep percolation of water applied to irrigated lands and seepage from conveyance canals (Stearns et al., 1938).

Deposits of the western SRPA transmit and yield considerably less water than do the basalt interflow zones of the eastern SRPA. Consequently, the productivity of the western SRPA is much less than the eastern SRPA although it is greatest in the Boise River valley (Lindholm, 1996).

Valley-fill aquifers in tributary valleys consist primarily of unconsolidated gravel, sand, silt, and clay and provide groundwater supply for various uses within the individual subbasins tributary to the Snake River. Wells in valley-fill aquifers generally are less than 200 feet deep.

Groundwater supplies most of the M&I water uses in the basin. The quality of groundwater generally is acceptable for most purposes and surpasses national drinking water standards. However, water quality measurements through 1986 indicated that about 10 percent of water samples from the eastern SRPA contain more nitrate than the drinking water standard of 10 milligrams of per liter (mg/L) (USGS, 1988). A ready avenue for transport of contaminants exists in areas where permeable rocks are common between land surface and the water table.

Groundwater recharge and discharge processes are linked closely with surface-water supply and use. Groundwater generally is recharged from river losses and from the infiltration of precipitation and irrigation applications while discharge is to wells, springs, and as river gains. Changes in river operations, irrigation diversions, or irrigation practices may impact groundwater supplies. For example, increasing irrigation efficiency by conversion from flood to sprinkler irrigation methods may lead to reduced diversions and immediately provide greater instream flow. Unless crop consumptive use declines (by crop conversion or reduced production), groundwater recharge would be decreased and long-term river gains will decline. Also, groundwater use may impact the surface-water supply. Groundwater withdrawals for irrigation and other uses may reduce river gains and increase river losses; artificial groundwater recharge may increase river gains and reduce river losses.

Groundwater budget data, both recent and historic, are insufficient to quantify relationships between groundwater and surface water in many tributary basins and areas adjacent to the Snake River downstream from Brownlee Reservoir. Reports that describe groundwater conditions for the Palouse River (Nassar and Walters, 1975) in Idaho; the Owyhee, Malheur, Burnt, and Powder Rivers (Newcomb, 1960) in Oregon; and the Columbia Plateau (Whiteman, K.J. et al., 1994) in Washington indicate that groundwater is an important component of the water supply in those basins, but that groundwater yield is minor compared to the overall surface-water supply of the Snake River basin.

2.3.1.1 Eastern SRPA

Springs that flow into the Snake River at Thousand Springs and into American Falls Reservoir between Neely and Blackfoot are major points of groundwater discharge from the eastern SRPA. Records indicate that spring discharge has been relatively stable in the Neely-Blackfoot reach of the Snake River at about 2,500 cfs from 1912 to 1980 (Kjelstrom, 1986).

In 1980, the Snake River gained about 1.9 MAF from groundwater inflow between Blackfoot and American Falls Dam and 4.7 MAF between Kimberly and King Hill (Lindholm, 1996). The river loses water upstream from Blackfoot and in the vicinity of Lake Walcott throughout the year. Practically all flow in the Snake River is diverted at Milner Dam for irrigation during the growing season.

The Thousand Springs reach effectively separates the groundwater hydrology of the eastern SRPA from that of the western SRPA. Much of the groundwater from the eastern SRPA discharges naturally to a series of spectacular springs that flow into the Snake River. About 50 percent of annual streamflow of the Snake River near King Hill is from groundwater discharge. Discharge from individual springs near King Hill ranges from a few hundred to several hundred cubic feet per second. Many spring outlets are located at the bottom of alcoves that extend hundreds of feet into the 300-foot-high north face of the Snake River canyon. Discharge from these springs supports the largest freshwater aquaculture industry in the world.

Irrigation water application after the late 1800s in excess of crop growth requirements added to the amount of groundwater in storage in the eastern SRPA and caused water levels in the aquifer system to rise. Discharge at Thousand Springs increased from about 4,200 cfs since the early 1900s to about 6,800 cfs by the mid-1950's, as shown on figure 2-2, as a result of increased groundwater storage and water level rises.

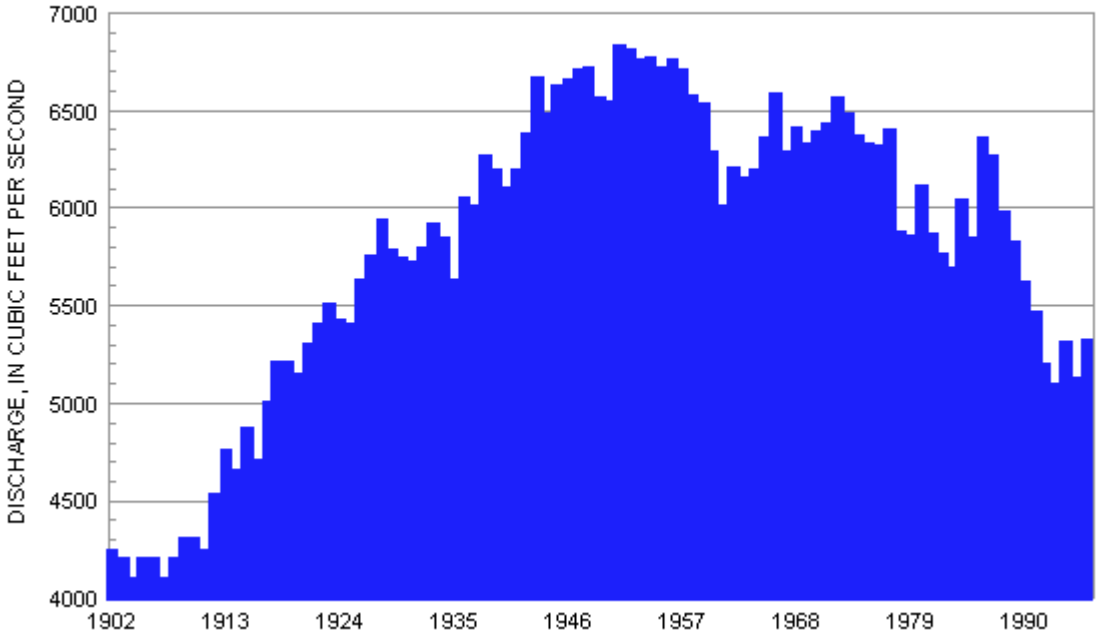


Figure 2-2 Groundwater Discharge from the Eastern Snake River Plain Aquifer to the Thousand Springs Reach of the Snake River, 1902 – 1996 (data provided by Tom Brennan, USGS, Boise, ID, 1997)

Spring discharge in the 1990s for the Milner Dam to King Hill reach has been in the range of 5,000-5,500 cfs. The stabilization and decline of spring discharge from highs in the mid-1950's have been attributed to the widespread increase in groundwater pumping for irrigation, a decrease in surface-water diversions for irrigation that corresponded with the conversion from flood to sprinkler irrigation, and periodic drought conditions. Changes in irrigation practices, river operations, and managed recharge activities in the Snake River plain could impact the groundwater hydrology of the eastern SRPA. Groundwater yield from basins tributary to the eastern SRPA totaled about 2,000 cfs in 1980 or about 15 percent of the recharge to the eastern SRPA (Garabedian, 1992). Therefore, irrigation practices and river operations that affect the hydrology in tributary basins could have a marked effect on the hydrology of the eastern SRPA.

2.3.1.2 Western SRPA

Interchange between groundwater in the western SRPA and the Snake River is less than 1,000 cfs (Kjelstrom, 1995). The Boise River is the largest tributary river that flows through part of the western SRPA and provides a water supply of sufficient magnitude to have made the lower Boise River valley the most productive part of the western SRPA. A comprehensive geohydrologic investigation of the lower Boise River valley is in the second of a 5-year study (Petrich, 1997). Changes in irrigation and river operations in the Boise and Payette Rivers could affect groundwater yield from the western SRPA in the Boise and Payette River valleys. Groundwater yield from other basins tributary to the western SRPA was negligible in 1980 (Kjelstrom, 1986).

2.4 Surface-Water/Groundwater Interactions and Usage

Surface-water and groundwater systems are hydrologically connected; that is, changes in recharge or discharge from the SRPA affect surface flows. Water infiltrating from irrigation and streamflow provides a significant portion of the groundwater budget. At other places, the Snake River channel is below the regional water table and the aquifer discharges to the river.

Conjunctive management of surface and groundwater appear to be increasing in importance as local declines in groundwater storage adversely affect spring flows and availability of groundwater for irrigation pumping. Conjunctive management is an issue for the Idaho Department of Water Resources (IDWR) and the Oregon Water Resources Department (OWRD) since the vast majority of groundwater withdrawals are typically by non-Reclamation junior water rights holders. The prospects for obtaining significant volumes of water for flow augmentation in association with conjunctive management are not promising due to the complexity of the interrelationships between groundwater and surface-water and the substantial time lag that is associated with groundwater depletions or recharge (whether natural or managed).

In the 1990's, two separate requests were made by those relying on spring flow discharge and groundwater to regulate upgradient pumping by junior water rights holders in Idaho. These actions created a flurry of increased activity and concern about the condition of the SRPA. One key court ruling found that IDWR must conjunctively manage groundwater and surface-water supplies and meet the prior rights of those relying on springflows at Thousand Springs.

2.5 Water Use

Reliable data on water use in the Grande Ronde and Salmon River basins was difficult to obtain in the timeframe for this analysis. Diversions and consumptive water use in these basins is primarily for irrigated agriculture, but the total quantity used in these two basins is relatively small compared to the rest of the Snake River basin. For this analysis, data on water use and consumption, is limited to the Snake River basin upstream of Brownlee Dam.

Irrigated agriculture accounts for almost 99 percent of all out-of-stream water diversions and groundwater pumping from the Snake River basin. Essentially all surface water diversions and about 95 percent of all groundwater diversions are used for irrigation. Virtually all domestic, public supply, and industrial requirements in the basin are met from the remaining 5 percent of groundwater diversions.

Reclamation (Reclamation, 1997) estimates that about 14.5 million acre-feet of water are diverted from streams and about 7.5 million acre-feet are pumped from groundwater in the basin upstream of Brownlee Dam. Of the streamflow diversion, Reclamation estimates that about 8.5 MAF return to the river or aquifers for a total consumptive use from surface diversions of 6 MAF.

In contrast, the Idaho Water Resource Board (IWRB) estimates that a total of about 16.6 MAF of surface waters are diverted and conveyed by more than 3,000 miles of canals and laterals to irrigated fields (IWRB, 1996). Of this amount, gravity diversions from the main Snake River total about 9.5 MAF, gravity diversions from tributaries total about 6 MAF, and pumpage from the main Snake River and tributaries totals about 1 MAF. In addition, about 3.5 MAF of groundwater, mostly from the upper Snake River basin, is annually supplied to agricultural lands. A comparison of surface-water diversions and groundwater withdrawals for irrigation based on IWRB data is shown in figure 2-3.

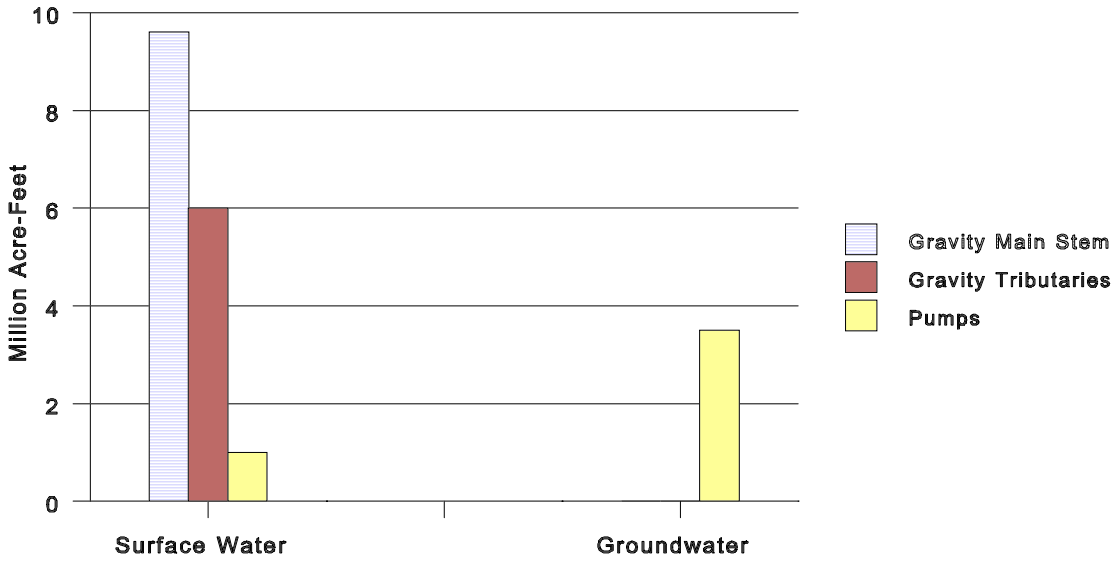


Figure 2-3 Surface Water Diversions and Groundwater Withdrawals

Most M&I water is supplied from groundwater utilizing private or public utility systems concentrated in the Boise, Pocatello, Twin Falls, and Idaho Falls areas and has no significant affect on reservoir operations. Industrial water is primarily used for food processing, including potato and sugar beets; phosphate mining/processing; dairy products production; and manufacturing. In the Boise valley, groundwater is also used in computer chip production.

2.6 River and Reservoir System Operations

An in-depth discussion on river and reservoir operations in the Snake River basin can be found in Reclamation's Combined Report (Reclamation 1996a, 1996b, 1997a). The discussion for this section has generally been summarized from those documents.

River and reservoir operations are based largely on state laws related to water resources, construction of large Federal Reclamation projects, and ownership and operation of major river control structures. Overriding much of the river operation by Reclamation, the Corps, and the IPC are water rights administered by the states, requirements for flood control operations specified in Federal legislation, and IPC operations requirements defined in its Federal Energy Regulatory Commission (FERC) licenses.

2.6.1 General Operation

Reclamation reservoirs are operated primarily for irrigation water supply and flood control. Hydroelectric power generation, recreation, and fish and wildlife functions (other than maintaining streamflows) are secondary or incidental to the project operations because water is generally not released specifically for those purposes. Each Reclamation facility was originally authorized by congressional legislation and constructed for specific purposes; however, subsequent Federal legislation has modified operational requirements and sometimes imposes significant constraints on how the individual facilities may be operated. Reclamation project operations include releases to meet earlier dated natural flow rights.

Operation strategies have been developed for all Reclamation reservoirs. At the end of the irrigation season in October (when most consumptive use demands have been met), many of the reservoirs are lowered or maintained at summer drawdown levels to leave sufficient storage space to control winter inflows. During the spring snowmelt period, reservoir storage and outflow are carefully controlled to protect and maintain facility integrity, protect downstream areas from flood damage, and fill the reservoirs as runoff declines. During the summer irrigation period, the reservoirs are drawn down to meet downstream irrigation needs.

Reclamation works closely with the watermasters to assure an exchange of information on streamflows and to assure that releases from storage meet irrigation demands. These procedures vary by basin and even by river reach. If the demand can be met from more than one reservoir, Reclamation decides from which reservoir to make releases. Watermasters rely on their respective state water resources department to help provide information and analysis for water diversions and deliveries to water users. A water rights accounting is maintained to assure that, regardless of where water is physically stored, the storage and use of water are properly accounted to the appropriate rights and spaceholders.

The Snake River reservoirs upstream of Milner Dam are operated as a unified storage system where water is stored and released in a manner that maximizes the capability of the storage reservoirs. This means that water is, to the extent possible, retained in those reservoirs that are most difficult to refill and released from the reservoirs that are most likely to refill in the following year. In practice, water is stored as far upstream as possible regardless of storage right priorities. The storage and use of water is properly accounted to the appropriate rights and spaceholders regardless of where water is stored or from where releases are made.

The Boise and Payette River systems are operated separately. The four reservoirs on the Boise River system are operated as a unified storage system and the two reservoirs of the Payette River system are operated as a unified system. In that way, the capability of the storage reservoirs is maximized. To the

extent possible, water is stored at the upper most reservoir (Anderson Ranch Reservoir) in the Boise system. In the Payette system, Cascade and Deadwood Reservoirs are operated in parallel to keep refill capabilities of the two reservoirs equal.

Reclamation storage reservoirs in other tributaries are operated independently by irrigation districts for irrigation water supply and, in some cases, flood control. The two reservoirs of the Baker Project are also operated independently of each other to serve lands in two separate areas. Although the multiple reservoirs of the Vale Project are operated as a unified system, the capability of maximizing storage is limited because each reservoir is located on a different tributary. However, some water can be moved from upstream reservoirs to the furthest downstream reservoir via a feeder canal. The general operating seasons for these basins are based on climatological pattern, runoff, and irrigation demand and are the same as for the upper Snake River reservoirs.

IPC operates most of the non-Federal hydroelectric powerplants in the basin. IPC facilities are the major source of control on the main stem Snake River from Milner Dam to Lower Granite Lake. Some of IPC facilities are essentially run-of-river powerplants with minimal storage capacity to adjust flows for short-term power needs. However, C.J. Strike, Brownlee, Oxbow, and Hells Canyon have sufficient storage to be operated on a seasonal basis.

2.6.2 Water Rights

Idaho State water law is based on the priority of appropriation or "first in time is first in right" principle, and the Idaho State Constitution affirms that all waters of the State are public waters. The IDWR's system for the regulation of water identifies beneficial uses and the amounts of water that individuals may use. Permits, licenses, and decrees (adjudicated water rights) indicate water may be diverted from streams or groundwater, the amount of water that may be diverted, the purpose, the diversion points, and how much water may be stored in reservoirs. Water rights considerations may reach beyond the initial diversion and application of water, extending to how and when the unconsumed water returns to the river system or to an aquifer. This is because of the large volumes of return flows and the interactions between groundwater and surface water. IDWR controls the process of distributing water and accounting the amount of use. Water from federally-developed storage is controlled further by contracts with the Federal government. Reclamation and State watermasters work closely in this process.

The States of Wyoming, Oregon, and Nevada also adhere to the prior appropriation doctrine, affirm that all waters of the state are public waters, and have a process for granting water rights. These procedures are slightly different in each state but have the same general goal of managing water for beneficial use. States use the concept of beneficial use to quantify the water right acquired under the prior appropriation doctrine; one is entitled to receive only that amount of water that is actually put to a use that is recognized as beneficial by the state.

Pursuant to the mandate of Section 8 of the Reclamation Act of 1902, Reclamation acquires water rights for its projects under state law. Reclamation most often has obtained its project water rights by making application to the appropriate state agency, which would grant water rights for the entire project in the name of the United States. The water rights were perfected when the project irrigators put the water to beneficial use and the state confirmed that use through issue of final water certificates or an adjudication. Oregon water rights system includes storage permits and primary and secondary permits for diversion from storage. The certificate, generally issued to the United States and held by the Bureau of Reclamation, describes the lands that receive the project water and also allows the storage of the project water in the reservoir. Federal and state laws generally recognize that the Reclamation project irrigators

jointly hold title to the project rights with the United States retaining legal title and irrigators holding beneficial title.
Reclamation holds title to the storage rights for all Reclamation storage facilities in the Snake River basin upstream above Milner Dam, in the Payette and Boise River basins, and in most other Reclamation reservoirs in the basin upstream of Lower Granite Lake. A compact between Idaho and Wyoming allows water stored in Jackson Lake and Grassy Lake to be used as though the reservoirs were located in Idaho. Reclamation also holds some natural flow rights. Some Oregon storage rights are held by irrigation entities and most natural flow rights are held by others.

A general adjudication of Idaho water rights in the Snake River basin was filed on December 19, 1987, and is ongoing in the 5th District Court of the State of Idaho for the County of Twin Falls (Case Number 39576). All water rights (surface and groundwater) claimed by more than 62,000 separate individuals and entities in the basin are included in the adjudication. Prior court decisions, Federal treaties, Federal contracts, and acts of Congress have bequeathed a legacy of uncertainty, confusion, and a multitiered system of irrigation delivery priorities. Reclamation claims use of water in the basin for several of its projects. The adjudication of water rights includes Federal reserved water right claims associated with the Shoshone-Bannock Tribes of the Fort Hall Indian Reservation and the Nez Perce Tribe. The Snake River basin adjudication is ongoing without a firm conclusion date.

A water rights agreement of 1990 among the Shoshone-Bannock Tribes, the State of Idaho, the United States, and certain Idaho water users settled litigation involving claims made by the United States on behalf of the Shoshone-Bannock Tribes to water rights in the upper Snake River basin and its tributaries. The agreement revised the date of natural flow rights belonging to the tribe to become the earliest date on the Snake River; retained the tribes storage rights; and provided storage space, without repayment obligations, to mitigate affected water users. A final consent decree concerning the tribes' rights to upper Snake River basin water was signed by the court.

The impetus for constructing most Reclamation dams in the Snake River basin, as elsewhere in the 17 Western States, was to provide a water supply for irrigation to reclaim arid lands. Construction of storage for irrigation water supply also provided the opportunity for some flood control. As a result, some reservoirs constructed fairly late in the development of the area include flood control authorization at the time of construction. In addition, Ririe and Lucky Peak Dams were constructed primarily for flood control. IPC constructed its facilities specifically to generate electricity. Other non-Federal reservoirs in the basin were constructed for a variety of purposes but primarily for irrigation.

Reclamation has spaceholder contracts with dozens of entities and supplies water when spaceholders call for their share. Through these contracts, irrigators are entitled to use storage space in Reclamation reservoirs by paying a portion of the project's construction costs and their share of allocated operation costs. The spaceholder contracts are a type of repayment contract that specifies the manner in which reservoirs are operated and includes provisions that Reclamation operate to maximize the available water supply. These spaceholder contracts provide the contractor with water that accrues to the contracted space with water being carried over to the next year up to the total of the contracted space. Spaceholder contracts at Reclamation reservoirs are in perpetuity (nonexpiring) while those for water in Lucky Peak Lake are 40-year renewable water-service contracts.

2.6.3.2 Irrigation

Most of the irrigated land upstream of Lower Granite Lake is located within the State of Idaho and amounts to more than 3 million acres. However, lands irrigated from the Snake River and its tributaries also include lands in western Wyoming, northern Nevada, and eastern Oregon. The average amount of land irrigated (and harvested) in the total region between 1988 and 1995 was nearly 3.4 million acres. Of this total, about 1.6 million acres are in Reclamation projects (receive all of the water or part of the water from Reclamation storage facilities).

Irrigated lands can be placed into three categories: (1) privately developed lands that receive a water supply from natural streamflows, groundwater, or private storage reservoirs; (2) privately developed lands that receive supplemental water from Federal storage developments; and (3) public domain lands for which a full irrigation supply was developed under the Federal Reclamation Act of 1902. Most, if not all of the water supply, for lands in the latter category is provided by the development of storage. All lands that receive a full or supplemental water supply from Reclamation (or Corps) developed storage are included in the statistics compiled for Reclamation projects and are considered to be Reclamation irrigated lands.

In this same area, during the 1988-1995 period, more than ½ million acres were dry-land farmed. It is clear that the factor limiting irrigated agriculture in this arid region continues to be water, not land availability. Early in this century, lands that were privately developed for irrigated agriculture often had an insufficient water supply. The development of water supplies by Reclamation, resulted in a conversion of lands from private irrigation to those included in Reclamation project. As soon as private lands received a supplemental water from Reclamation sources, Reclamation classified them as Federal irrigation. Nonetheless, many of these lands still receive the major source of water from natural flow rights that predate development of Reclamation storage.

Cropping patterns vary throughout the region, although alfalfa and pasture are found in all regions and are the major crops in the Grande Ronde River basin. Potatoes, wheat, and other grains are important in most regions. Sugar beets along with dry edible beans are important crops in the south-central part of Idaho. The reader is directed to chapter 6 for more detail on irrigated agriculture in the region.

2.6.3.3 Flood Control

The Act of September 30, 1950, authorizing the construction of Palisades Dam, by reference, authorizes the Reclamation reservoirs upstream of Milner Dam to be operated for flood control. In addition, the Flood Control Act of 1944 and other related acts have essentially authorized flood control at all Reclamation reservoirs. Under the Flood Control Act of 1944, the Corps is tasked with identifying flood control needs and developing flood control procedures as needed at Federal facilities.

Formal flood control rules have been developed under Section 7 of the 1944 Flood Control Act for many Reclamation reservoirs which are then operated with flood control as one of the primary operating purposes. In some cases, Reclamation has independently developed flood control rules for some reservoirs and requires the operating entities to follow those rules. Coordinated operations among several reservoirs and several agencies in parts of the Snake River basin provide the greatest flood control protection.

Flood control requirements are an important and complex operational consideration since they involve public safety and protection of property. Complexity arises from the uncertainty of runoff forecasting and attempts to balance flood control against reservoir refill for irrigation water supply.

2.6.3.4 Power Generation

Hydroelectric powerplants owned and operated by Reclamation and the Corps (Federal facilities) were constructed and are operated under Congressional authorization, while public and private powerplants (non-Federal facilities) are operated under FERC licenses. Several hydroelectric powerplants have been constructed and are operated by non-Federal entities at Reclamation dams. These powerplants are operated under FERC regulations.

Hydropower is specifically mentioned in the original authorization of several Reclamation reservoirs as shown on table 2-1. However, water is not released specifically for power generation at Reclamation reservoirs. Power generation depends on the releases of water for other project purposes. There are two exceptions to the above: (1) where there was a water right for power generation at the site prior to construction of the Reclamation dam and (2) when a power generating entity has a contract for storage space in a Reclamation reservoir. In these cases, Reclamation releases water as required to meet the water right or the contract.

Power generation is the major operating consideration at dams and diversions owned by IPC and at some other facilities authorized under FERC regulations. Many of these are run-of-river facilities that generate electricity with little or no change in streamflow. Some of the IPC facilities have sufficient storage capacity to shape flows and generate electricity to follow load demands. These non-Reclamation facilities are operated to maximize revenue within the limits of the FERC licenses and state water rights and have seasonal, daily, and diurnal variations in power revenue per kilowatt-hour.

There are 36 hydroelectric powerplants with a nameplate capacity greater than 5 megawatts (MW) in the Snake River basin upstream of Brownlee Reservoir. Reclamation and IPC facilities account for most of the installed capacity in the basin. Chapter 6 and attachment D provide specific information on the powerplants that were modeled and evaluated in this flow augmentation analysis.

2.6.3.5 Municipal and Industrial Water (M&I)

Municipal and Industrial (M&I) water supply is not a consideration in current river and reservoir operations in the basin. There are only three contracts for M&I water in Reclamation storage space for a total of 4,800 acre-feet of space in Anderson Ranch and Lucky Peak Lake. The procedure for releasing and accounting this water is essentially the same as for irrigation water contracts.

Most M&I water is supplied from groundwater using private or public utility systems which are concentrated in Boise, Pocatello, Twin Falls, and Idaho Falls. Reservoir operations are not modified to meet groundwater M&I needs.

2.6.3.6 Recreation

Recreation is specifically authorized at some Reclamation reservoirs as shown on table 2-1. Public Law 89-72 and Public Law 102-575 authorized construction of recreation facilities and management of lands for recreation purposes (including fish and wildlife enhancement) at all Reclamation projects. However, these laws do not authorize a change in the use of storage space or operation of reservoirs for recreation purposes.

Some FERC permits for hydropower facilities also address recreation and have provisions for adjusting releases specifically for recreation or water quality. Examples include the Milner Powerplant, the American Falls Powerplant, and the Cascade Powerplant (all operated by IPC).

2.6.3.7 Fish and Wildlife

Authorities under which the Reclamation dams and reservoirs were constructed and are now operated do not generally include fish and wildlife enhancement, except as provided under Public Law 89-72 and Public Law 102-575. Existing provisions for fish and wildlife enhancement are generally limited to managing land surfaces and providing protective measures, but do not include managing the water supply for that purpose. Fish and wildlife operations are included in the original authorizations of specific projects as shown on table 2-1.

Snake River facilities, in recent years, have been managed to accommodate fish and wildlife concerns including protecting species listed under the ESA. Reclamation operations include streamflow augmentation downstream of some dams and maintenance of reservoir conservation pools at some reservoirs to help maintain and support fish and wildlife habitat, water quality, and recreation. Operational considerations include target conservation pools and streamflows along with providing water to augment flows for salmon migration in the lower Snake River. Reclamation's objective has been to meet the contractual obligations and meet fish and wildlife considerations where practicable.

Reclamation's ROD in response to the 1995 BIOP and an agreement among Reclamation, IPC, and the USFWS form the basis for current operations to provide salmon flow augmentation in the lower Snake River. Reclamation obtains water for this purpose, under the authority of the ESA, from uncontracted storage space, acquisition of contract entitlements at Reclamation reservoirs, acquisition of natural flow water rights, and annual purchases of water from rental pools. Reclamation recently submitted a BA (Reclamation, 1998) to the NMFS and USFWS on the operation of its projects above Lower Granite Lake and the impacts on endangered plants, animals, and fish.

Some FERC licenses have provisions for protecting fish and wildlife. These provisions have generally included physical or operational modifications to help maintain water quality. In recent years, some IPC facilities have been required under FERC licenses to consider ESA species.

2.6.3.8 Water Quality

Water quality of reservoir pools and associated downstream river reaches is an operating concern. In most cases, Reclamation addresses water quality concerns at reservoirs by designating a specific volume of uncontracted storage space to be used as a conservation pool. Maintaining a conservation pool is also a means of addressing downstream water quality concerns when it is known that low pool elevations result in release of sediment from the reservoir. Reclamation also designates volumes of uncontracted storage space to be used to maintain the water quality of downstream reaches. These designations are made with the full realization that conservation pools and minimum flow targets for downstream reaches may not be achievable in drought conditions. Where there is no uncontracted storage space, Reclamation is without means of independently addressing water quality.

2.7 Agency and Entity Responsibilities

Federal, state, private, and local entities are involved in operation of the Snake River system. Operating entities are responsible for operating within the parameters of Federal and state laws and regulatory agencies are responsible to assure that operations are within those parameters.

2.7.1 Reclamation

Reclamation is responsible for the operation of its facilities, whether those facilities are operated directly by Reclamation staff or operated by the contracting entities. All Reclamation facilities are operated in accordance with authorizing and subsequent Federal legislation and state laws and in cooperation with the Corps and state water resource agencies. Reclamation coordinates its operations with all involved Federal, state, and local entities.

Storage contracts, in general, limit water operations to those that provide benefit to contract holders. State water law limits appropriation of water to beneficial uses and defines those uses. Nonetheless, there remains flexibility to address some fish, wildlife, and recreation preservation and enhancement concerns.

In effect, Reclamation is the primary entity involved in regulating flows in the Snake River upstream of Milner Dam since all of the major storage is owned and/or operated by Reclamation. The same is true for the Boise and Payette Rivers since all of the major storage, with the exception of Lucky Peak, is owned and operated by Reclamation. In other tributaries with facilities owned by Reclamation but operated by contracting entities, Reclamation has a more limited role but maintains certain responsibilities for maintenance, operation, and coordination.

2.7.2 Corps

The Corps is responsible for the operation of Lucky Peak Dam. More importantly, the Corps, through the Flood Control Act of 1944, is the responsible Federal agency for developing flood control rules and for oversight of flood control at all Federal dams. Reclamation and the Corps cooperatively develop formal flood control rules for the operation of many dams. During the flood control season, the Corps and Reclamation independently develop runoff forecasts, compare those forecasts, and then decide on a single runoff forecast for flood control operation. The Corps and Reclamation work closely to coordinate operations.

2.7.3 State Water Resource Agencies

The States of Wyoming, Idaho, Oregon, and Nevada have all adopted the prior appropriation doctrine for water rights (see Water Rights section) and have developed procedures for the administration of water rights. State water resource agencies have been created to handle the administration of state laws related to water. Included in their responsibilities are overseeing the water rights process (establishing, permitting, and issuing water rights), water distribution including protection of water rights, and adjudication. Other activities can relate to dam safety, floodplain management, groundwater recharge, and state waterbanks. State agencies are often charged with identifying problems and needs and with developing state water plans for the future development and administration of water resources.

State agencies most concerned with the geographical area identified for this flow augmentation analysis are: Wyoming State Engineer, IDWR, IWRB, Nevada Department of Conservation and Natural Resources, Oregon Water Resources Commission, and OWRD.

2.7.4 Idaho Power Company (IPC)

IPC owns and operates several major dams with hydropower facilities within the Snake River basin. IPC has the responsibility to operate its facilities according to the FERC licenses and according to the water rights administered by IDWR. FERC licenses are site specific and may address requirements to operate for flood control, recreation, water quality, and fish and wildlife protection and enhancement. Except where constrained by specific provisions within the individual project FERC licenses, or other agreements, IPC operates all of its facilities to maximize the reliability and economic benefits of power generation. IPC is now involved in the relicensing process as many of its projects will soon be up for renewal.

In recent years, IPC has modified its Brownlee operations, in coordination with NMFS and BPA, to provide augmentation flows for endangered salmon. IPC carefully protects its ability to manage Brownlee Dam, its only significant storage facility, for power generation purposes. For this analysis Reclamation has assumed that Brownlee operations would continue as in the recent past. The extent to which Brownlee operations could or should be further modified for salmon flow augmentation is a matter that appears to require the direct involvement of IPC. There is one change that would be required to provide an additional 1MAF and would affect IPC. IPC, with support from other Idaho interests, has insisted that releases past Milner Dam be made at levels not to exceed 1,500 cfs. This constraint could not be maintained if an additional 1 MAF is provided downstream.

2.8 Natural Resources

A wide variety of natural resources and habitats are found in the Snake River basin. Some fish and wildlife species are resident while others are migratory and some are native while others are introduced. Cold water fish species, including anadromous fish, are the major management focus of fishery agencies, but a variety of warm water fish species are also present and managed as productive fisheries.

Many wildlife species, including a number of ESA-listed species, depend upon the unique habitats provided by the Snake River system for all or part of their existence. Of particular note are birds. One of the largest concentration of nesting raptors in the world is found in the Snake River Birds of Prey National Conservation Area located along the main stem Snake River. Reservoirs and lakes provide essential habitat for migrating waterfowl. American Falls is in the North American Waterfowl Management Plan - Waterfowl Habitat Area of Special Concern.

Coniferous and deciduous forests, scrub-shrub wetlands, emergent wetlands, and other habitats, provide food and cover for waterfowl, shorebirds, marsh birds, wading birds, aquatic and other furbearers, large ungulates, and other wildlife.

Riverine islands, some of which are under Federal or state protection, provide unique sanctuary and protection for waterfowl. Approximately 260 islands exist between Palisades and the confluence of the Henrys Fork and hundreds of islands can be found between the Henrys Fork confluence and Brownlee Dam.

Fish, wildlife, and habitats that could be affected by providing flow augmentation water are more fully described in chapter 7.

2.9 Social Aspects

Indigenous native peoples populated the area for thousands of years. In the mid 1800s, two Indian reservations were established in the general geographic area covered by this analysis. These are the Fort Hall Indian Reservation located along the Snake River in eastern Idaho and the Duck Valley Indian Reservation located in south Idaho and northern Nevada. The Indian tribes that live on these two reservations, tribes associated with other reservations, and tribes without reservations retain specific rights with respect to the use and harvest of natural resources in the Snake River basin. The Fort McDermitt Indian Reservation (Nevada and Oregon), the Umatilla Indian Reservation (Oregon), and the Coeur d'Alene Indian Reservation (Idaho) are located just outside the boundaries of the area covered by this analysis.

Idaho was predominantly rural from the time it was a territory until the 1960's and 1970's when manufacturing, services, and other sectors began growing and populations became more concentrated around specific communities. The economy of the State has been based on the stable agricultural industry as well as timber and mining. Western Wyoming, eastern Oregon, and northern Nevada are largely rural with economies based primarily on agriculture and livestock, food processing, and timber. Much of the economy of these areas is closely linked to the Snake River due to the arid climate. Agriculture and the related infrastructure throughout the Snake River basin is heavily influenced by the irrigation of land. The climate makes irrigation essential to intensive agriculture.

Irrigated agriculture was the focus for the development of many communities and continues to be a dominant economic force in many of those communities. Irrigation areas associated with Reclamation projects are located in three major areas: (1) southeastern Idaho from American Falls on the main stem to Ashton on the Henrys Fork, (2) southern Idaho along the main stem from the confluence of the Big Wood River to Minidoka, and (3) western Idaho along the lower Boise and Payette River and eastern Oregon along the lower reaches of the Owyhee and Malheur Rivers. Reclamation projects and private irrigation have been developed on several other tributaries.

Some communities have developed economies primarily related to tourism and recreation, e.g., Jackson, Wyoming and Cascade, Idaho. Much of the tourism and recreation in these and other areas is also dependent on streams and flatwater including natural lakes and Reclamation storage reservoirs. Recreation is dependent on a good water supply, water quality, and the presence of sufficient populations of fish and wildlife. State and local economies are dependent on the river and associated fish, wildlife, and vegetation. A more detailed discussion of social aspects is in chapter 8.

---

i. Contracted and Formally Assigned space categories are given to the nearest 1 acre-foot; other space categories are rounded to the nearest 100 acre-feet. As a consequence totals for some columns reflect rounding errors.

ii. Except for Minidoka and Lucky Peak, all contracts are spaceholder (share of reservoir capacity) repayment contracts. Minidoka storage is included in the original Minidoka Project and addressed in conventional repayment contracts. Lucky Peak contracts are spaceholder water service contracts, which are subject to for renewal in 2005 - 2008.

iii. Above the spillway and not storable.

iv. Purchased by Reclamation for salmon augmentation flow.

v. Dead storage is a natural lake, the volume of which has not been determined.

vi. Designated for mitigation of Safety-of-Dams repairs to Deer Flat Dam.

vii. Reserved for powerhead.

viii. Includes 250,000 acre-feet for minimum pool and 19,900 acre-feet designated for reservoir evaporation accounting.

ix. Reserved for sediment control and needed for use with 250,000 acre-feet minimum pool to maintain water quality and endangered bald eagles.

x. Includes 49,900 acre-feet for minimum pool and 29,750 acre-feet reserved for Deadwood River streamflow maintenance.

xi. Nominal amount.

xii. Reserved for sediment control.

xiii. Corps of Engineers facility with irrigation water marketed by the Bureau of Reclamation.

xiv. Boise River streamflow maintenance of which 50,000 acre-feet is reserved for the Idaho Department of Fish and Game.

xv. Transferred (3,554 acre-feet) or purchased (37,378 acre-feet) by Reclamation for salmon augmentation flow.

xvi. Corps of Engineers dead pool for reservoir fishing.

xvii. Reserved for sediment control.

xviii. Provides head for north side and south side Minidoka canals and Minidoka Powerplant.

xix. Repurchased by Reclamation for salmon flow augmentation.

xx. Reserved for powerhead.

xxi. Exclusive flood control.

xxii. Reserved for sediment control.

xxiii. Provides head for irrigation outlet.

xxiv. Reserved for sediment control.